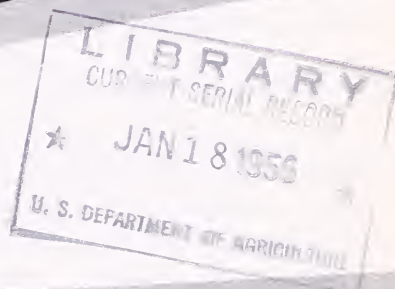


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Preferences for Canned Grapefruit Juices



U. S. DEPARTMENT OF AGRICULTURE

Agricultural Marketing Service
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MARKETING RESEARCH REPORT NO. 108

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PREFERENCES FOR CANNED GRAPEFRUIT JUICES ^{1/}

By Hugh P. Bell, social science analyst,
Market Development Branch
Marketing Research Division

SUMMARY

The purpose of this research was to determine consumers' preferences for canned grapefruit juices that varied in several respects: Brix-acid ratio (with degrees Brix constant), natural-flavor vs. sugar-added, and unlabeled vs. labeled juices ("sweetened" - "unsweetened"). This study was undertaken as an aid to improvements in the marketing of canned grapefruit juices.

The natural-flavored juices tested were at 7, 9, 11, and 13 Brix-acid ratio levels, and those with sugar added were at 9, 11, 13, and 15 Brix-acid ratio levels. The series of juices at 9, 11, 13, and 15 Brix-acid ratio levels were obtained by adding sugar to the natural-flavored juices at 7, 9, 11, and 13 Brix-acid ratios respectively. Increase in Brix-acid ratio brings about a change from relatively tart to relatively sweet in these juices. The universe sampled was all persons 16 years of age and over in households in Indianapolis, Ind. The sample was composed of 640 households which included 1,352 eligible participants. One-half of the households received juices that were labeled either "sweetened" or "unsweetened" and the other half received juices in cans with no labels. Each juice was rated by from 140 to 190 people. Each respondent rated a specified juice on 3 consecutive days, and a week later rated another juice on 3 consecutive days. The experiment was designed so that throughout the sample, within the 2 sample groups, every juice was paired with each of the other juices in the 2-week sequence. Certain households, randomly determined, received the same juice for the 2 tests without being so informed.

^{1/} The research on which this report is based was conducted under authority of the Agricultural Marketing Act of 1946.

The Florida Citrus Commission and the University of Florida Citrus Experiment Station cooperated in this research. The juices were processed and supplied by the two Florida organizations. The field work and tabulations of data were done under contract by S-D Surveys, Inc.

The author is indebted to the following persons for their assistance: James A. Bayton, formerly in the Market Development Branch; Robert W. Olsen, University of Florida Citrus Experiment Station; L. G. McDowell, Florida Citrus Commission; and Carol Cruikshank and Thomas Semon of S-D Surveys, Inc.

The results of the study show that: (1) The labeled juices, whether labeled "sweetened" or "unsweetened," received higher preference ratings than the unlabeled juices. (2) The sweetened juices received higher preference ratings than the unsweetened juices. (3) Within the unsweetened juices at 7, 9, 11, and 13 Brix-acid ratio levels, the juice at 7 Brix-acid ratio was least preferred. There were no significant differences in the ratings for the natural-flavored juices at 9, 11, and 13 Brix-acid ratios. (4) Within the sweetened juices at 9, 11, 13, and 15 Brix-acid ratio levels there were no significant differences in the preference ratings. (5) The preference position of the canned grapefruit juices, particularly the sweetened ones, is quite favorable in relation to frozen concentrated orange juice, frozen concentrated grapefruit juice, and canned orange juice. The sweetened juices were generally preferred over frozen grapefruit juice and canned orange juice, and were preferred over frozen orange juice by some respondents. (6) Over half of the respondents expressed a willingness to have each of the canned grapefruit juices--with the exception of the juice at 7 Brix-acid ratio--served in their homes.

The results of this research indicate that producers can best meet general consumers' preferences for canned grapefruit juice by marketing sweetened juices at from 9 to 15 Brix-acid ratio when degrees Brix is at 11.6 to 12.6. The required notations "sugar added" or "sweetened" could serve to enhance favorableness of reaction to the juices. When natural flavored canned grapefruit juices are marketed, they should be at from 9 to 13 Brix-acid ratio when degrees Brix is at 10.

PURPOSE OF STUDY

In developing and marketing food products, producers need basic information on the reactions of consumers to the various characteristics of the products in deciding what form consumers will prefer. One of the most important characteristics of canned grapefruit juice, and believed most likely to influence consumer reactions, is the tart-sweet characteristic. Since it is possible for the tart-sweet level of canned grapefruit juice to vary widely, producers of this product need to know the tart-sweet level which has highest preference among consumers. In order to determine this, consumer reactions to the tart-sweet possibilities must be measured.

The physical factors in grapefruit juice that determine its tart-sweet characteristics are measurable in terms of degrees Brix and Brix-acid ratio. Degrees Brix is a measure of the specific gravity of a sugar solution. If the specific gravity of a sugar solution is 12.08 ° Brix and its acidity is 0.81 gram per milliliter, the Brix-acid ratio is 14.9 to 1, computed by dividing 12.08 by 0.81. As the Brix-acid ratio increases at a constant number of degrees Brix, the juices become less tart and increase in sweetness.

The purpose of this research was to determine consumer preferences for canned grapefruit juices that varied in Brix-acid ratio, with degrees Brix, peel oil content, and pulp content held constant. Two sets of juices were used in determining this, one with the Brix-acid ratios based on the natural sugar and the other with the Brix-acid ratios based on the addition of sugar

to obtain the desired Brix-acid ratio levels. In addition, the research was designed to determine what effect knowledge or lack of knowledge that the juices were sweetened (sugar-added) or unsweetened (natural-flavor) had on preferences. This was accomplished by labeling one-half of the juices and not labeling the other half. The latter had no label at all and were identified by code.

Four natural-flavored juices were tested at Brix-acid ratio levels of 7, 9, 11, and 13 with degrees Brix constant at 10. Four sweetened juices were tested at Brix-acid ratio levels of 9, 11, 13, and 15 with degrees Brix at 11.6 to 12.6. The sweetened juices were obtained in the following manner: Sugar was added to the 7 Brix-acid ratio juice to raise the Brix-acid ratio level to 9, sugar was added to the 9 Brix-acid ratio juice to raise the Brix-acid ratio level to 11, and so forth. The lowest Brix-acid ratios were relatively tart and the highest were relatively sweet. The particular Brix-acid ratio range tested in this research was recommended by representatives of the Florida Citrus Commission and others in the citrus industry.

In addition to determining preferences for the above juices, interviews were conducted with each homemaker as to her general use of and attitudes toward fresh, canned, and frozen orange and grapefruit juice.

This research was conducted in Indianapolis, Ind., in October and November of 1954.

THE SAMPLE

The universe sampled was all of the households within the city limits of Indianapolis, Ind. An area probability sample to yield 640 households was drawn. To be eligible each household had to have some type of refrigeration.

Preference data were obtained from those members of selected households who were 16 years of age and over. Each homemaker, that person in the household who had major responsibility for purchasing and preparing the food, was interviewed concerning the use of fresh, canned, and frozen orange and grapefruit juice. This interview was conducted on the first call to a household.

Of the original 640 households, 622 participated throughout all phases of the research.

EXPERIMENTAL DESIGN

The original 640 households were selected 5 to a block through 128 blocks. In order to measure the effect of labeling the experimental juices either "sweetened" or "unsweetened," the 128 blocks were divided into 2 sets of 64 each with 320 households receiving labeled juices throughout the test and 320 receiving unlabeled juices. The assignment of the juices to the households was randomly determined. The interviewer left a sufficient supply for each eligible person to be able to drink the juice on 3 successive days. One week after completion of the first test each of the households was given

another juice to judge. Each juice was randomly assigned to one-eighth of the households that had a given juice in the first week. For example, 40 households had the 7 Brix-acid ratio juice unlabeled the first week. Of these, in the second week 5 households received the 7 Brix-acid ratio juice unlabeled again, 5 received the 9 Brix-acid ratio juice unlabeled, 5 received the 11 Brix-acid ratio juice unlabeled and so forth. In this manner, every possible combination of 2 of the 8 juices in each respective group (labeled and unlabeled) occurred in the 2 weeks.

The households that received unlabeled juices were supplied with coded, but otherwise unidentified, 10-ounce cans. The households that received labeled juices were supplied with coded 10-ounce cans with one of the following identifications: SWEETENED FLORIDA GRAPEFRUIT JUICE or UNSWEETENED FLORIDA GRAPEFRUIT JUICE. No brand name appeared on the label, but in other respects it was comparable to ordinary labels.

When a juice was delivered to a household, the homemaker was asked to place it in her refrigerator immediately. The tests were to begin the following day and this insured that the juices would be chilled when served for the preference ratings. Fresh cans had to be opened each time the preference ratings were to be given.

In judging the juices the respondents used the scale shown in figure 1. The reliability of this scale has been determined in prior research.^{2/} A juice was rated each day for 3 successive days. Each respondent was asked to make his ratings independently of the other members of the household. The instructions for using the scale were as follows:

"From the 'Rating Scale' you will see that your opinion about this juice may be expressed as falling anywhere from 'Very Poor' up through 'Excellent.' Put a cross (X) in the ONE block that expresses your opinion about this juice."

This scale is scored 1 to 10, going from the bottom to the top "blocks." As previously stated, all persons 16 years of age and over in a household gave preference ratings. From 140 to 190 people gave preference ratings for each of the respective juices.

On the third day of testing a juice the respondents were asked to check those items on a list which they thought best described that juice. These items were categorized in terms of sweetness, tartness or sourness, body or consistency, tinniness and artificiality.

RATING SCALE	
Used to Measure Preferences	
EXCELLENT	☐
	☐
	☐
	☐
	☐
	☐
	☐
	☐
	☐
VERY POOR	☐

PUT "X" IN BLOCK THAT EXPRESSES YOUR OPINION

U.S.D.A. NEG. 1782-55(8) AGRICULTURAL MARKETING SERVICE

Figure 1

^{2/} Bayton, J. A., Bell, H. P., Preference for Canned Orange Juices that Vary in Brix-acid Ratio. Market. Res. Rpt. 76, U. S. Dept. Agr., Dec. 1954.

Clements, F. E., Bayton, J. A., Bell, H. P., Method of Single Stimulus Determinations of Taste Preference. Jour. Appl. Psychol., vol. 38, No. 6, 1954.

In addition, on the third day of experience with a juice the respondents were asked to express their willingness to have the juice served in their homes if it were on the market. Also, a paired comparison technique was used to evaluate each of the test canned grapefruit juices in contrast to frozen orange juice, canned orange juice, and frozen grapefruit juice, in general.

Finally, when the interviewer returned to pick up the test results the homemaker was asked if she would be willing to buy the juice for use in her home.

In each household the homemaker assumed responsibility for explaining the procedure to the other members and keeping the records for the return visits of the interviewer.

PREFERENCE PATTERNS FOR CANNED GRAPEFRUIT JUICES

The preference patterns for the canned grapefruit juices are shown in figure 2 (tables 1 and 2, appendix). The mean preference ratings are for all respondents rating a given juice. These data were based upon the mean ratings per individual for the 3 test days.

Results of the analysis of variance of the data show 3 main effects with regard to preferences for these canned grapefruit juices: (1) labeling, (2) sweetened vs. unsweetened, and (3) Brix-acid ratio within the unsweetened juices.

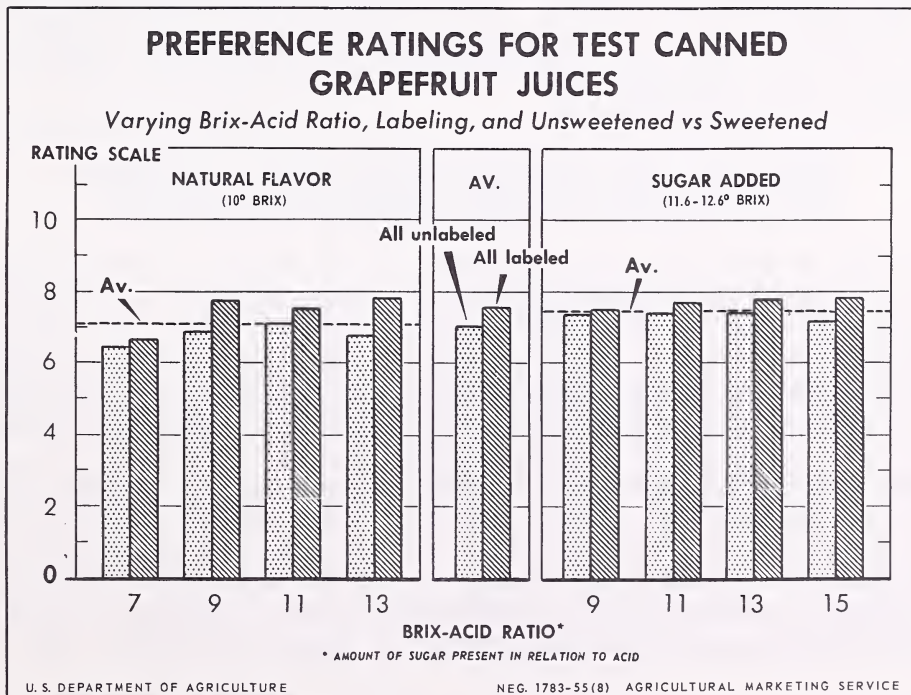


Figure 2

Preferences for All Labeled vs. All Unlabeled Juices

It will be recalled that the sample was divided into 2 groups. One group received juices that were labeled either "sweetened" or "unsweetened" and the other group received juices that were in unlabeled cans, without knowledge as to whether the juices were sweetened or unsweetened. Based on the difference between the mean of all labeled juices--7.56--and the mean of all unlabeled juices--7.07--the former were significantly preferred over the latter. This was true whether the juices were labeled "sweetened" or "unsweetened." Not only on the average were all labeled juices rated higher than the unlabeled juices, but this was also true for each of the juices; when any one of the juices was labeled either "sweetened" or "unsweetened" its preference rating increased over the unlabeled juice. It would appear that labeling unsweetened juices brings about a greater increase in the preference ratings than does labeling the sweetened juices (fig. 2).

Preferences for All Sweetened vs. All Unsweetened Juices

When sugar was added to the natural flavored juices at 7, 9, 11, and 13 Brix-acid ratios in the amounts necessary to raise their respective Brix-acid ratio levels approximately by 2, the resultant sweetened juices were significantly preferred over the unsweetened juices. This is seen in the difference between the mean of all sweetened juices--7.51--and the mean of all unsweetened juices--7.12--(fig. 2). It appears, however, that it was among the unlabeled juices that the preference for the sweetened over the unsweetened juice was most marked.

Although the above data indicate preference for the sweetened over the unsweetened canned grapefruit juices, prior research has indicated that greater intensity is found among those who do prefer the unsweetened juices. In other words, they are less likely to be satisfied with a sweetened juice if an unsweetened one is not available. ^{3/}

Preferences for Brix-acid Ratio Within Sweetened and Unsweetened Juices, Disregarding Labeling

Comparison of the preference ratings for the juices at the various Brix-acid ratios within the unsweetened set shows that only one is significantly different from the others. The juice at 7 Brix-acid ratio was rated significantly lower than the juices at 9, 11, and 13 Brix-acid ratios. Within the sweetened juices there were no significant differences in the ratings of the juices at 9, 11, 13, and 15 Brix-acid ratios (fig. 3, table 2, appendix).

Although all of the sweetened juices received higher preference ratings than all of the unsweetened juices, the above data seem to point to the fact that 9 Brix-acid ratio (either sweetened or unsweetened) represents the point at which the most preferred juices begin to be encountered. Among the unsweetened juices a shift from 7 to 9 Brix-acid ratio brings the juices to a plateau of preference that extends through 13 Brix-acid ratio. The lowest of

^{3/} Bayton, James A., and Meyers, Trienah. Consumers' Use of and Opinions About Citrus Products. Bur. Agr. Econ., Oct. 1951.

the sugar-added juices was 9 Brix-acid ratio and the preference data for the juices through 15 Brix-acid ratio again represents a plateau of preference (fig. 3).

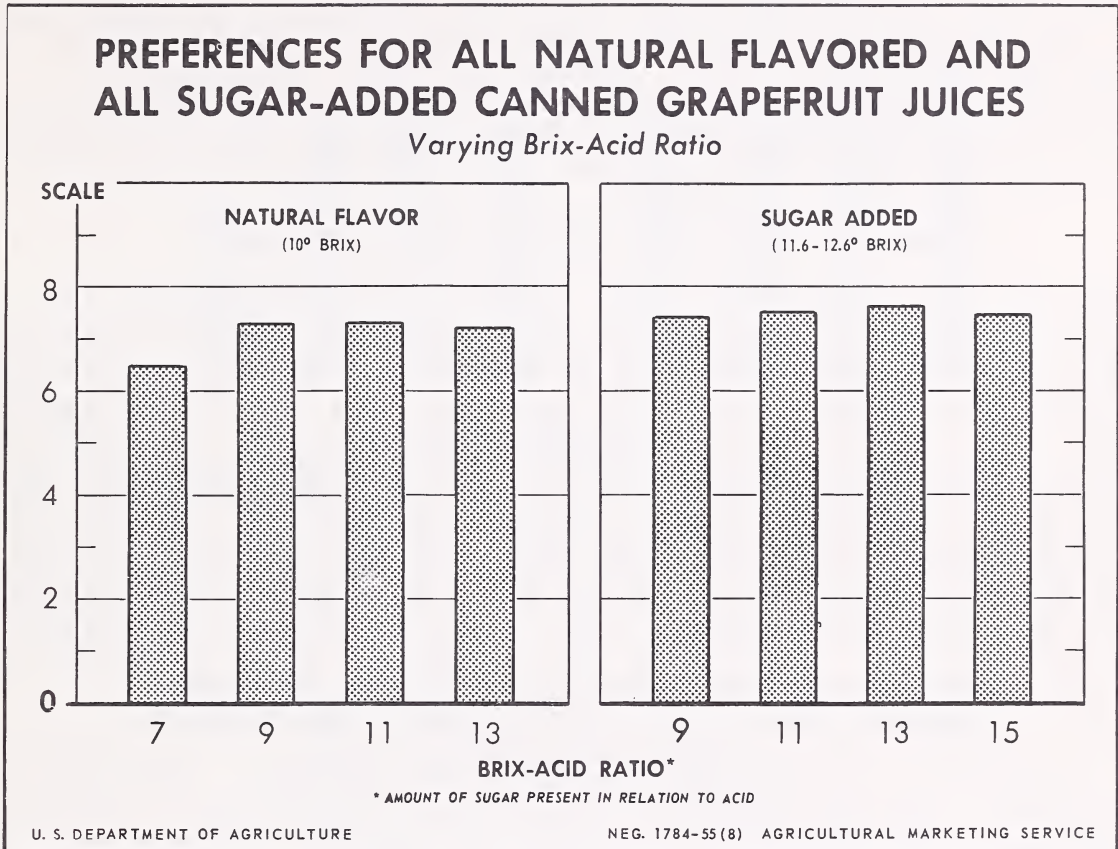


Figure 3

Preference by Age, Sex, and Family Income

Examination of the preference ratings by age, sex, and family income groups revealed overall patterns that were essentially the same as those already described for the total sample. For example, regardless of the age group, the sweetened juices were assigned higher preference ratings than the unsweetened juices, and the labeled juices were assigned higher ratings than the unlabeled juices.

The younger respondents (16 to 20 years old) tended to assign lower ratings to all of the juices than did the older age group. However, among these respondents, the addition of sugar enhanced their preferences more than it did those of the older age groups (table 3, appendix).

The preference ratings revealed no significant differences with respect to the sex of respondents (table 4, appendix).

The respondents in the low-income group tended to give all of the juices higher preference ratings than did the middle-income and high-income groups. Labeling had a greater effect on raising the preference ratings among the respondents in the low-income and high-income groups than in the middle-income group (table 5, appendix).

Producers can best meet general consumers' preferences for canned grapefruit juice by marketing sweetened juices at from 9 to 15 Brix-acid ratio when degrees Brix is at 11.6 to 12.6. Labeling the juices "sugar-added" or "sweetened" as required by law could serve to enhance favorableness of reaction to them. When natural-flavored canned grapefruit juices are marketed, they should be at from 9 to 13 Brix-acid ratio when degrees Brix is at 10.

ACCEPTANCE OF CANNED GRAPEFRUIT JUICES FOR HOME USE

The pattern of preference ratings does not necessarily reflect the extent to which people would actually like to have the product served in their homes. Nor does it necessarily reflect upon the homemakers' reactions toward buying the product, and whether or not their buying reactions reflect their family's wishes. To investigate these relationships, the respondents', including the homemakers', willingness to have each juice served in their homes, and the homemakers' willingness to buy the respective juices was ascertained. After the third day of drinking a particular juice, each respondent was asked the following question: "If a juice that tastes just like this one was on the market would you like to have it served here in your home?" When the interviewer returned to the household to pick up the test results the homemaker was asked this question: "If the price were satisfactory, would you buy the canned grapefruit juice you have just tested for use here in your home?"

The results of the analysis of these data are shown in figures 4 and 5. It is evident that the preference pattern of the respondents' expressions of willingness to have the respective juices served in their homes is generally the same as the pattern based on the preference ratings. Likewise, the preference pattern of the homemakers' expressions of willingness to buy the respective juices is generally the same as the pattern based on the preference ratings. It can also be seen that the preference pattern of the homemakers' expressions of willingness to buy the respective juices supports the pattern of all respondents' expressions of willingness to have the juices served in their homes.

The highest proportions of positive expressions of willingness to have the juices served are found among those respondents who had labeled juices and those who had sweetened juices. Within the unsweetened and sweetened juices, respectively, the pattern is similar to those based upon the preference ratings.

Evidence of the strength of the homemakers' expressions of willingness to serve and to buy the respective juices can be found in the results shown in figure 6. It will be recalled that personal willingness to have a juice served in the home was ascertained when the juice was tested on the third day; however, the homemaker was not asked about her willingness to buy until

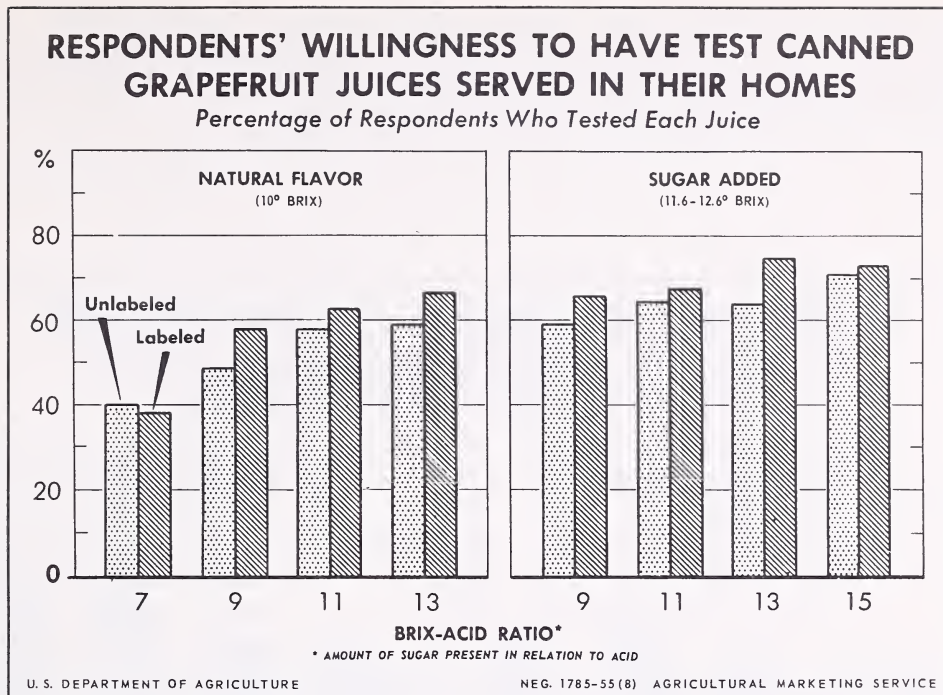


Figure 4

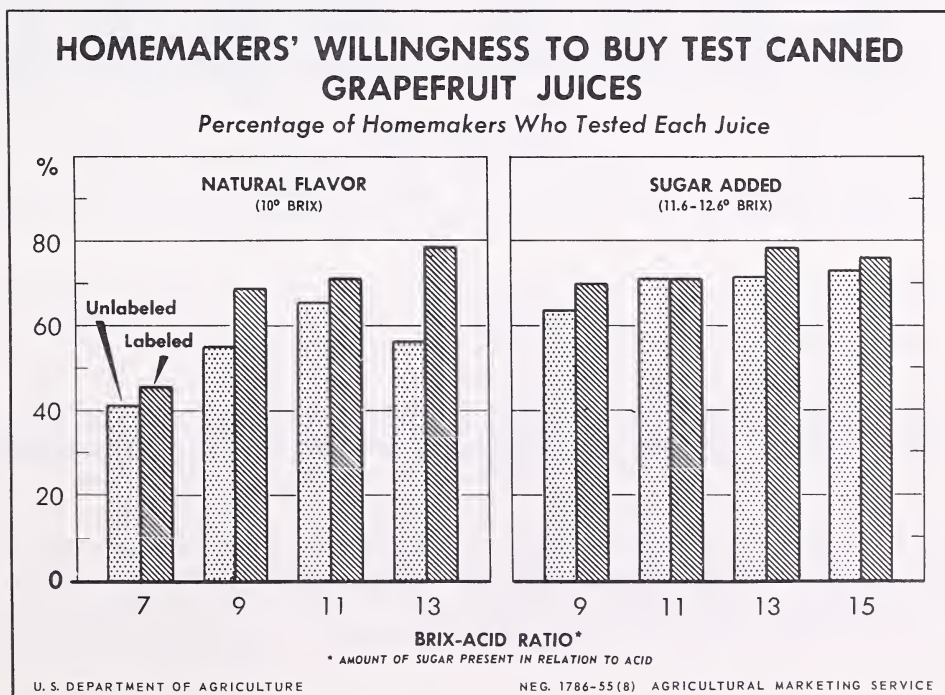


Figure 5

the interviewer returned to pick up the test results 3 days later. The pattern of the results in figure 6 shows that the homemakers would not only like to have the juice served to themselves personally but that they would be willing to buy the juice to serve in their homes.

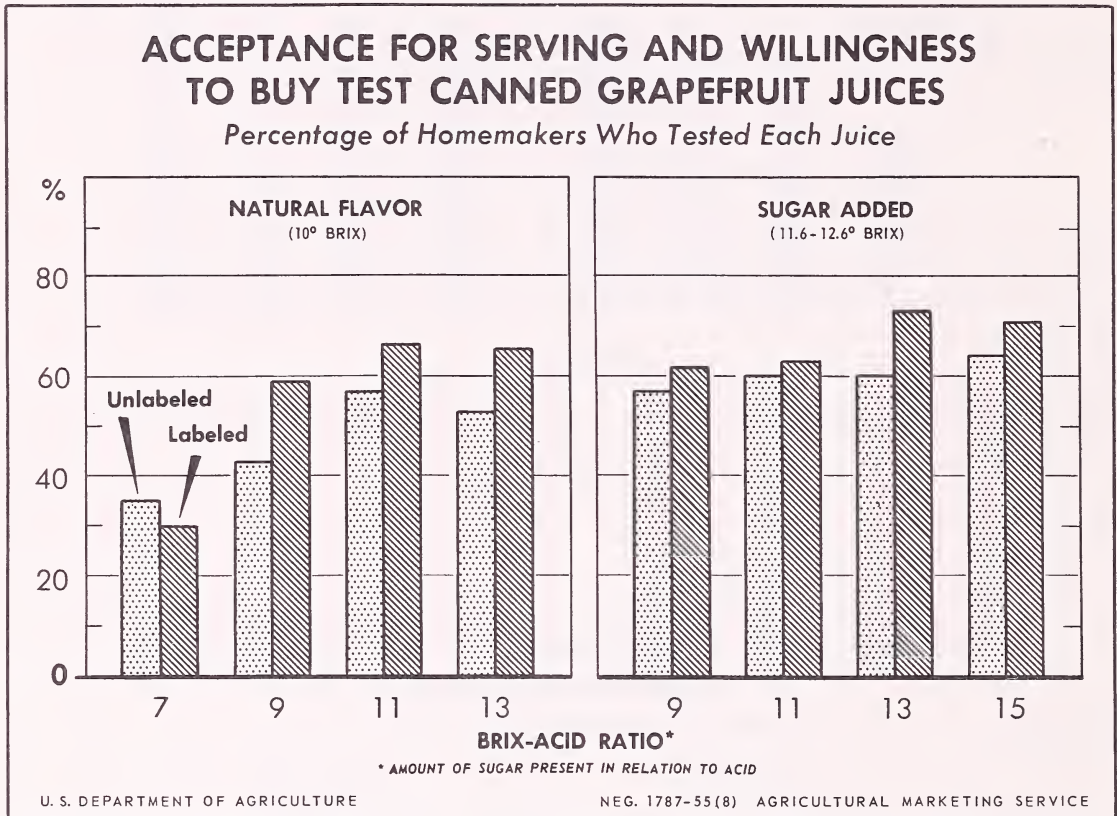


Figure 6

RELATIVE PREFERENCES FOR TEST CANNED GRAPEFRUIT JUICES, FROZEN CONCENTRATED ORANGE JUICE, FROZEN CONCENTRATED GRAPEFRUIT JUICE, AND CANNED ORANGE JUICE

In order to determine the relative preference position of the respective test canned grapefruit juices among competing citrus products, each respondent was asked to compare each juice he had tested with frozen orange juice, frozen grapefruit juice, and canned orange juice. These comparisons were made by the

respondent after testing a given juice on the third day. To establish the relative preference positions of the test juices and the competing products the method of paired comparisons was used. In this method the respondent was asked to give his preference when a test juice was paired with every competing product. The expressed preferences were based on the following question and checklist:

"Which would you prefer to have served here in your home --?"

CHECK ONE ITEM IN EACH OF THE PAIRS

This canned grapefruit juice	or	frozen grapefruit juice
Frozen grapefruit juice	or	frozen orange juice
Frozen orange juice	or	this canned grapefruit juice
This canned grapefruit juice	or	canned orange juice
Canned orange juice	or	frozen grapefruit juice
Frozen orange juice	or	canned orange juice

This procedure permits the establishing of a scale of preference. Not only are the products ranked in the order of preference but the "psychological distances" between products can be learned. Merely establishing the rank order of the products would not show the nature and magnitude of the separation between the products.

Preference scales were developed for each of the test canned grapefruit juices. Two sets of scales were developed, one for ALL respondents and the other for those respondents living in households where frozen orange juice had been served within the last year. In a given scale the product which had the highest preference rating was assigned a value of 100 and the other items were scaled downward from this point. Although the most preferred item on any one scale is assigned a value of 100, its psychological value may vary from scale to scale. The two sets of scales are shown in figures 7 and 8.

Inspection of the scales for ALL respondents reveals that frozen orange juice was generally preferred over the unsweetened canned grapefruit juices. With the exception of the juice at 7 Brix-acid ratio, the unsweetened canned grapefruit juices were preferred over canned orange juice, and the frozen grapefruit juice was least preferred in each comparison. When each of the sweetened canned grapefruit juices was compared with the other products, the sweetened juices, with one exception, ranked first. Frozen orange juice was preferred over the labeled test juice at 9 Brix-acid ratio but at Brix-acid ratios of 11, 13, and 15, it was second in preference, with canned orange juice and frozen grapefruit juice taking the third and fourth preference positions respectively (fig. 7). Respondents making these comparisons included those in 30 percent of the households who had not used frozen orange juice within the last year.

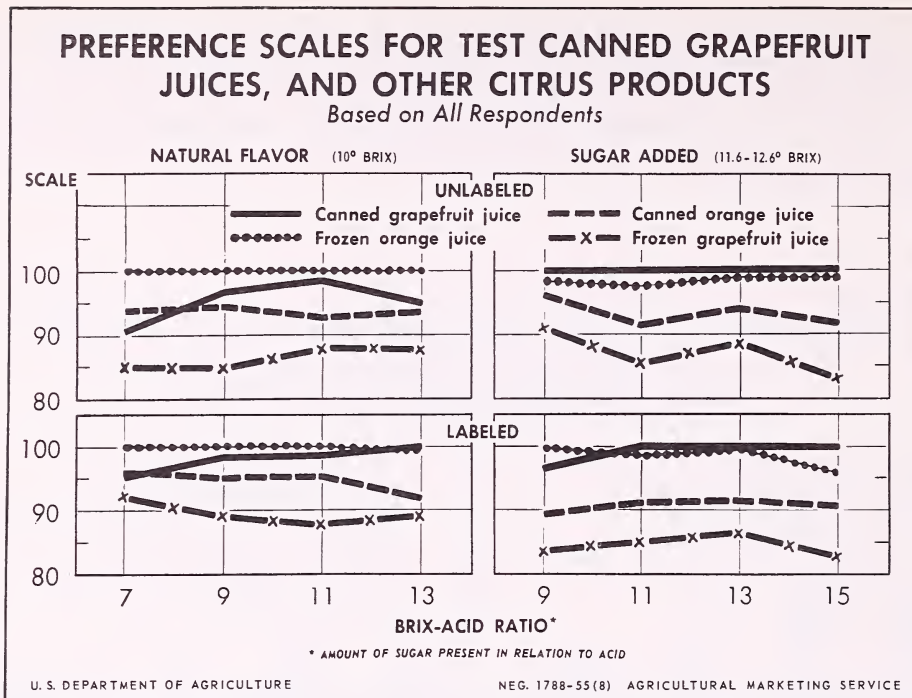


Figure 7

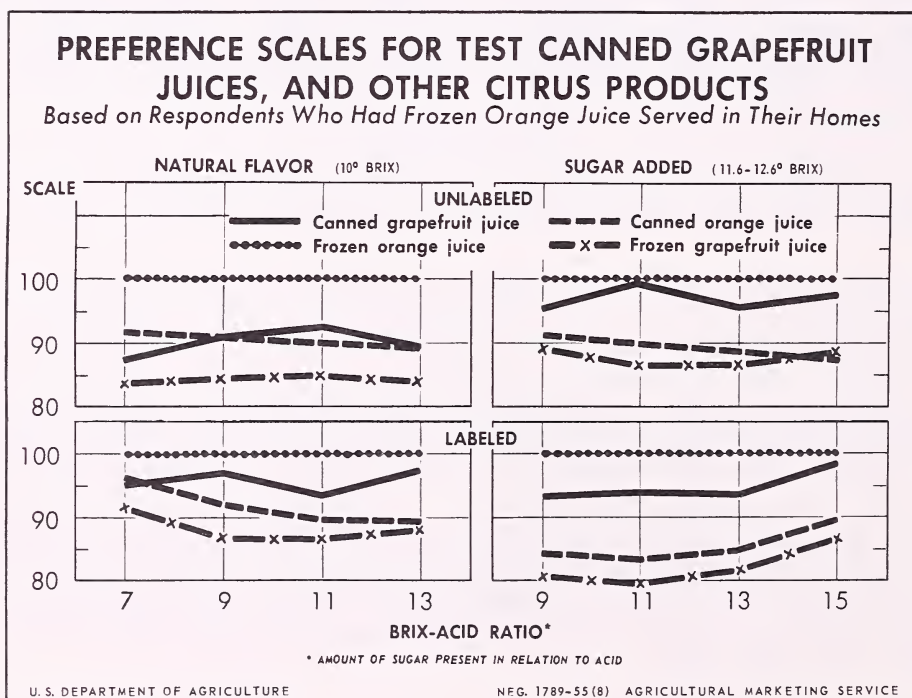


Figure 8

The pattern of the preference positions of the canned grapefruit juices duplicates the patterns based on the preference ratings and the expressions of willingness to have the juices served. This is true whether the canned grapefruit juices are in first or second position. Among the unsweetened juices, the preference position is low at 7 Brix-acid ratio and relatively high from 9 to 13 Brix-acid ratio levels. Among the sweetened juices the preference position is comparatively level from 9 to 15 Brix-acid ratio.

The data showing that, for all respondents, the test canned grapefruit juices tended to be preferred to frozen orange juice, were subjected to further analysis. Scales for those respondents living in households where frozen orange juice had been served within the last year were developed. These scales reveal that frozen orange juice was preferred over each of the test canned grapefruit juices. Generally each of the canned grapefruit juices ranked second in preference position, with canned orange juice and frozen grapefruit juice being least preferred (fig. 8).

Other evidence of the differences in the preference positions of the test canned grapefruit juices assigned by the two groups of respondents can be seen in the scale distances between the products within the respective sets of scales. Generally the scale distances were considerably greater between frozen orange juice and each canned grapefruit juice for those respondents who had served frozen orange juice in their homes than was true for ALL respondents. Other differences in scale distances are particularly marked between the two sets of scales within the sweetened juices. The set of scales within the sweetened juices for those respondents who had had frozen orange juice served in their homes shows a more marked separation between the two most preferred juices and the two least preferred than is true for all respondents (figs. 7 and 8).

These findings suggest that the canned grapefruit juices used in this study occupy a relatively strong preference position in relation to canned orange juice and frozen grapefruit juice, particularly if the juices are sweetened. In relation to the frozen orange juice, its preference position is favorable.

VALIDITY OF PREFERENCE RESULTS

As stated, the canned grapefruit juices varied from 7 to 13 and from 9 to 15 in Brix-acid ratio levels. Essentially this means the juices varied from relatively tart through sweet. The respondents were not informed that it was this particular aspect of the juices that was under investigation. An attempt was made, however, to discover whether this variable was, in fact, functioning in the respondents' judgments. That such was the case is seen in the replies to the descriptive checklist each respondent used after testing the juice on the third day.

None of the juices was described as being too sweet by any sizable proportion of respondents. Where differences in Brix-acid ratios did occur, the proportion of respondents describing the juices as being too sweet increased with the Brix-acid ratio. On the other hand, the proportion of respondents describing the juices as being too tart or sour decreased with increasing Brix-acid ratio levels (table 6, appendix).

RELIABILITY OF PREFERENCE RATINGS

In the design of this experiment, certain households which tested a given juice the first week tested the same juice the second week without being informed that they had received identical juices. This feature provided an opportunity to investigate the reliability of the preference ratings.

A total of 181 respondents, representing 80 households randomly distributed throughout the sample, received identical juices the first and second weeks. The mean of the individual difference, of all respondents, between the first and second week's ratings was 0.1104. When this difference was tested for significance, it was found to be well below the level necessary to show a significant difference (t value = 0.6250). This is in agreement with the reliability of the preference rating procedure found in other research. ^{4/}

INTERVIEWS WITH HOMEMAKERS

Use of Fresh, Frozen Concentrated, and Canned Orange and Grapefruit Juices

About two-thirds of the homemakers interviewed reported using each of the respective forms of orange juice within the last year. Sixty-nine percent of the homemakers had used frozen concentrated orange juice, 67 percent had used fresh orange juice, and 65 percent had used canned orange juice (table 7, appendix).

Approximately 67 percent of the homemakers used canned grapefruit juice within the last year. However, the number of homemakers who had used either fresh or frozen concentrated grapefruit juice was considerably less. Only 24 percent of the homemakers had used frozen concentrated grapefruit juice, and only 34 percent had used fresh grapefruit juice (table 7, appendix). It will be recalled that when frozen grapefruit juice was compared with the test canned grapefruit juice, frozen orange juice, and canned orange juice, it was least preferred. This could have been a reflection, in part, of the respondents' lack of experience with the product.

^{4/} See footnote 2.

The proportion of homemakers using either frozen orange or grapefruit juice tended to increase with family income. On the other hand, the proportion of homemakers in the lower and middle income groups using canned orange juice was higher than for the high income group. The proportion of homemakers using canned grapefruit juice was about the same for all income groups (table 3, appendix).

The frozen and canned orange and grapefruit juices tended to be used in about the same amounts throughout the year by a high proportion of the homemakers; fresh orange and grapefruit juice tended to be used more during the winter months. Those homemakers reporting seasonal differences in the use of frozen concentrated orange and grapefruit juice tended to use more of them during the summer months (table 9, appendix).

Of the homemakers who reported using a given juice, a high proportion served the juice at least several times a week during the period of greatest use (table 10, appendix).

Family income did not seem to be an important factor in the frequency of serving during the period of greatest use (table 11, appendix).

The use of orange juice in all forms reported here is in high agreement with the use reported by homemakers in the Indianapolis study of consumer preferences for canned orange juices, conducted a year previously.^{5/} For instance, in the earlier study, 70 percent of the homemakers had used frozen concentrated orange juice, 68 percent had used fresh orange juice, and 62 percent had used canned orange juice (compare table 7, appendix).

Reasons Given for Infrequent Use or Nonuse of Orange and Grapefruit Juice

The main reasons for either infrequent use (less than several times a week) or nonuse of canned orange and grapefruit juice were the same, although the proportion of homemakers citing them differed. Sixty-one percent of homemakers who had not used fresh orange juice and 34 percent who had not used fresh grapefruit juice gave the reason of difficulty of preparation; while 47 percent of the infrequent users of fresh orange juice and 48 percent of the infrequent users of fresh grapefruit juice cited the same reason.

Difficulty of preparation was the main reason given for infrequent use or nonuse of fresh orange and grapefruit juice. In the case of fresh grapefruit juice, 52 percent of the nonusers gave the reason that they preferred to eat the fruit whole. Cost was also mentioned by a smaller proportion of the homemakers who used these two products infrequently (tables 12 and 13, appendix).

The predominant reason given for infrequent use or nonuse of frozen orange and grapefruit juice was food habits. Of the homemakers who were nonusers, 46 percent gave this reason, of those who were infrequent users,

^{5/} See footnote 2.

68 percent. Among the infrequent users and nonusers of frozen orange juice, about 20 percent of the respective homemakers gave as their reason that it was too expensive (tables 12 and 13, appendix).

Reasons given for nonuse of canned orange and grapefruit juice had to do with food habits and the taste of the canned juices. Reasons having to do with taste included, "too bitter or acid," "tastes artificial," "too tinny or metallic" (tables 12 and 13, appendix).

Among the infrequent users of canned orange and grapefruit juice the respective homemakers accounted for the infrequency mainly in terms of food habit, i.e., seldom think of it, use it only for variety, etc. (tables 12 and 13, appendix).

DISCRIMINATION BETWEEN CANNED GRAPEFRUIT JUICES THAT VARY IN BRIX-ACID RATIO

As a supplement to prior research conducted to determine ability to discriminate between canned orange juices that varied in degrees Brix and Brix-acid ratio ⁶/₉, tests were conducted to establish ability to discriminate between canned grapefruit juices that varied in Brix-acid ratio. The juices tested were the same juices that were used in the preference tests in Indianapolis. The tests were conducted during November and December 1954.

Procedure for Discrimination Tests

The subjects used in these experiments were Washington employees of the Department of Agriculture. All of the subjects were untrained tasters. Each subject was asked not to smoke for 15 minutes and not to eat for 30 minutes before coming to the test room.

In the testing room the juices were placed in an electric refrigerator at least 12 hours before each test, to bring them to a temperature comparable to that of ordinary home refrigeration. The temperature at tasting was 50° - 55° F., comparable to that at which such juice would ordinarily be served in the home. The juices were served in non-waxed paper cups.

The test used was what is known as the "duo-trio" test. The subject tasted first a control juice, then two test juices. One of the test juices was the same as the control juice; the other different from it. The subject then indicated which of the two test juices was thought to be different from the control juice.

Each subject tasted two sets of the same juices, making two judgments for a given pairing. A swallow of water was taken before tasting each set of juice.

The following instructions were given to each subject: "This is an experiment on the ability of people to detect differences in canned grapefruit juices. You are going to taste 3 juices. One of the last 2 will be different

⁶/ Bayton, J. A., and Bell, H. P., Taste Tests on Canned Orange Juices. Bur. Agr. Econ., June 1953.

from the first juice. I want you to tell me which of the last 2 is the different one. Remember now, there are 3 juices -- 1 of the last 2 is different from the first. You are to see if you can tell me which one is different."

In presenting the juices, 4 sequences were used for each pairing:

1	2	3
Control	- Control	- Test
Control	- Test	- Control
Test	- Control	- Test
Test	- Test	- Control

The particular 2 sequences given to a subject were determined by randomization.

The experimental design was set up on the basis of 18 subjects making the test from a given pairing. This would mean 36 judgments for a particular test, as each subject made 2 judgments. On the basis of 36 judgments, 25 would have to be correct and 11 incorrect, to yield a result showing that ability to discriminate is significant at the 0.05 level. Therefore, in any given test whenever 12 incorrect judgments had been accumulated, that particular test was discontinued. This is the level of reliability commonly employed in work of this kind; it means that there are no more than 5 chances in 100 that the distribution of the judgments is the result of chance.

Discrimination of Brix-acid Ratio With degrees Brix Constant at 10.0 -- Natural-Flavor

Four canned grapefruit juices with Brix-acid ratios of 7, 9, 11, and 13 were used in these tests. Starting with the juice of 13 Brix-acid ratio, pairings were made with the juices in order of decreasing Brix-acid ratios. Discrimination occurred when the 13 Brix-acid ratio juice was paired with the 7 Brix-acid ratio juice (fig. 9; table 14, appendix).

Discrimination of Brix-acid Ratio With degrees Brix Constant at 11.6 to 12.6-- Sugar-Added

The 4 canned grapefruit juices used in these tests had Brix-acid ratios of 9, 11, 13, and 15. These ratios were obtained by adding sugar to the 4 above juices in the following manner: Sugar was added to the 7 Brix-acid ratio juice to make a juice of 9 Brix-acid ratio, sugar was added to the 9 Brix-acid ratio juice to make a juice of 11 Brix-acid ratio, etc.

Starting with the juice of 15 Brix-acid ratio, pairings again were made with the juices in order of decreasing Brix-acid ratios. Discrimination occurred when the 15 Brix-acid ratio juice was paired with the 11 Brix-acid ratio juice. The 11 Brix-acid ratio juice was then paired with the 9 Brix-acid ratio juice and these 2 juices were not discriminable (fig. 9; table 14, appendix).

Discrimination of degrees Brix With Brix-acid Ratio Constant
at 9 and 11

To test whether or not the addition of sugar necessary to increase the Brix-acid ratios of the juices by 2 produced discriminable juices, 2 pairings were made. The juices with Brix-acid ratios of 9 and 11 and with degrees Brix at 10 and 12.6, and 10 and 12.2 respectively were paired. Neither pairings proved discriminable (fig. 9, table 15, appendix).

Discrimination When degrees Brix and Brix-acid Ratio
Vary Simultaneously

To test ability to discriminate when degrees Brix and Brix-acid ratio vary simultaneously two pairings were made, one with the lowest ratios and the other with the highest ratios. The juice with degrees Brix at 10 and 13 Brix-acid ratio was discriminable when paired with the juice with degrees Brix at 11.6 and 15 Brix-acid ratio. Likewise, the juices with degrees Brix at 10 and 12.6 and Brix-acid ratios of 7 and 9 respectively were discriminable (fig. 9; table 16, appendix).

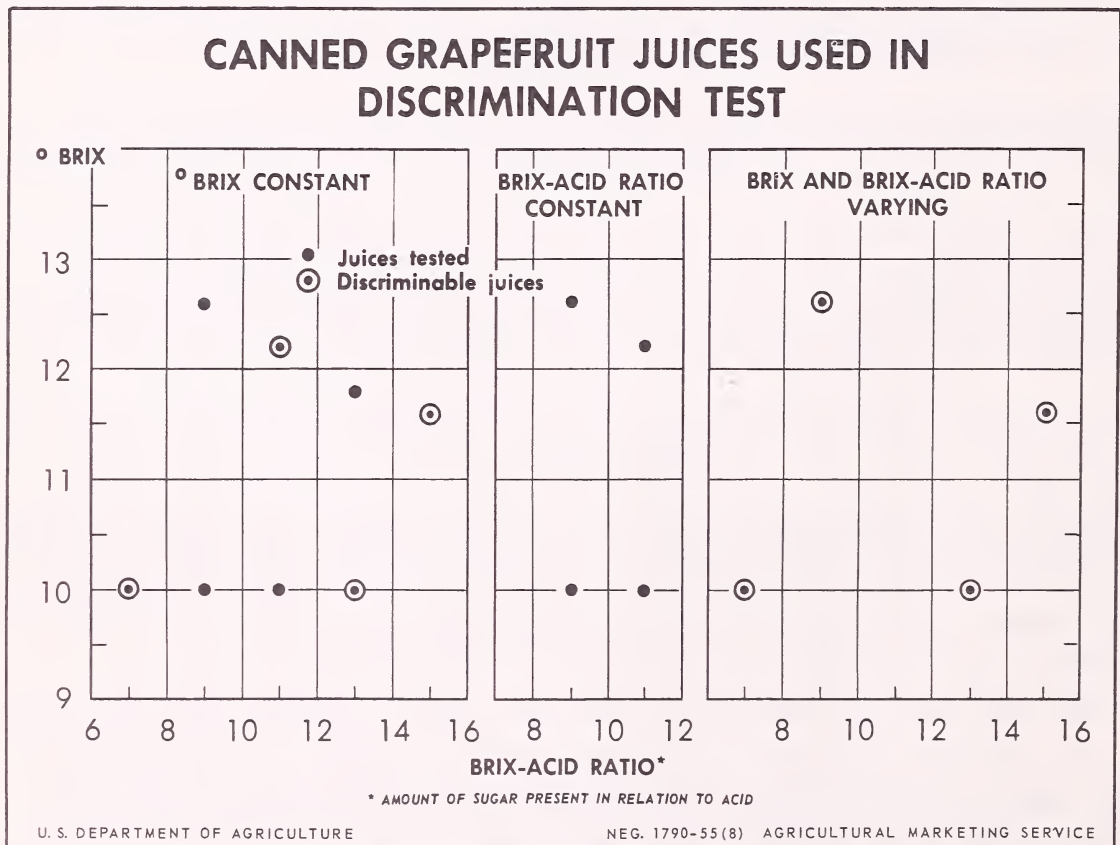


Figure 9

Meaning of Discrimination Tests Results

Two main conclusions may be drawn from the results of the discrimination tests. Ability to discriminate between juices that varied in Brix-acid ratio was essentially the same whether the juices were natural-flavored or sweetened. Differences in ability to discriminate between canned grapefruit juices and canned orange juices that vary in Brix-acid ratio are approximately of the same magnitude. In previous research on ability to discriminate between canned orange juices, a magnitude of approximately 5 Brix-acid ratios was needed to establish definite discrimination when degrees Brix was constant. ^{1/}

Although the data from these tests are not conclusive, evidence indicates that ability to discriminate between canned grapefruit juices and canned orange juices when degrees Brix and Brix-acid ratio vary simultaneously is also about the same.

On the basis of the findings from both sets of discrimination tests, it would appear that the discriminatory function with regard to degrees Brix and Brix-acid ratio is the same for canned orange and grapefruit juice.

It will be noted from the results of discrimination tests that ability to discriminate between some of the canned grapefruit juices submitted to preference testing did not meet the significance level criterion established for discrimination tests. As previously stated, the discrimination tests of the canned grapefruit juices were conducted to supplement prior research on ability to discriminate between canned orange juices that varied in Brix-acid ratio and not for the purpose of selecting juices to be submitted to preference testing. Inclusion of items which do not meet the established significance level criterion of the laboratory discrimination tests for preference testing is technically sound. Because of the severity of the criterion used to establish significant discrimination and because comparative judgments were made in only one experimental session, juices significantly differentiated are almost certain to be distinguishable in future experiments; however, many juices that may well be distinguishable in future experiments may fail to be significantly separated by such tests.

The experimental design utilized in preference tests may detect differences of lesser magnitude between items. Preference tests are based on large numbers of respondents and the "method of single stimulus" used to measure preference calls for evaluation of one item at a time in the experimental session. It will be recalled in this study that ability to discriminate between the natural-flavored juices at 7 and 9 Brix-acid ratios was not significant. However, the juice at 9 Brix-acid ratio was preferred over the juice at 7 Brix-acid ratio. One is forced to conclude that there were real differences between the 2 juices. On the other hand, one should not conclude that 2 juices with equal preference ratings are not discriminable. Among the sugar-added juices in this study there were no significant differences in the preference ratings for 9, 11, 13, and 15 Brix-acid ratios. However, the discrimination tests showed the juices at 11 and 15 Brix-acid ratios to be discriminable.

^{1/} See footnote 6.

APPENDIX

Table 1.--Preference ratings for test canned grapefruit juices

Item	Natural flavor 10° Brix, with Brix-acid ratio of --				Sugar added 11.6° - 12.6° Brix, with Brix-acid ratio of --			
	7	9	11	13	9	11	13	15
Unlabeled juices:								
Mean -----	6.44	6.89	7.12	6.78	7.38	7.40	7.46	7.17
Number of people -----	163	190	151	177	164	153	154	147
Labeled juices:								
Mean -----	6.62	7.79	7.53	7.81	7.55	7.65	7.77	7.80
Number of people -----	171	168	169	171	140	162	160	150

Table 2.--Analysis of variance of the preference ratings

Source of variation	Degrees of freedom	Sum of squares	Mean square	F ^{1/}
Juices -----	7	3.0814	0.4402	
Natural flavor vs. sweetened --	1	1.2286	1.2286	11.9 **
Between natural flavor juices--	3	1.8015	1.8015	5.8 **
Between sweetened juices -----	3	.0513	.0171	
Labeled vs. unlabeled -----	1	1.9356	1.9356	18.8 **
Weeks -----	1	.0034	.0034	
Error ^{2/} -----	22	2.2658	.1029	
Total -----	31	7.2862	--	--

^{1/} Double asterisk denotes significance at the 1-percent level.

^{2/} All interactions were tested and found to be nonsignificant. They were then pooled together and used as experimental error to test the main effects.

Table 3.--Mean preference ratings for sweetened and unsweetened, and labeled and unlabeled canned grapefruit juices, by age of respondent

Flavor and labeling	Age of respondent					
	16 - 20 years		21 - 34 years		35 years and over	
	Mean	Number of re-spondents	Mean	Number of re-spondents	Mean	Number of re-spondents
Flavor:						
Sweetened -----	7.22	85	7.47	370	7.58	773
Unsweetened -----	6.44	115	7.11	397	7.20	842
Labeling:						
Labeled -----	6.98	104	7.62	387	7.59	794
Unlabeled -----	6.55	96	6.93	380	7.18	821

Table 4.--Mean preference ratings for sweetened and unsweetened, and labeled and unlabeled canned grapefruit juices, by sex of respondents

Flavor and labeling	Sex of respondents			
	Male		Female	
	Mean	Number of respondents	Mean	Number of respondents
Flavor:				
Sweetened -----	7.49	536	7.58	693
Unsweetened -----	7.09	591	7.13	769
Labeling:				
Labeled -----	7.57	561	7.56	730
Unlabeled -----	7.00	566	7.13	732

Table 5.--Mean preference ratings for sweetened and unsweetened, and labeled and unlabeled canned grapefruit juices, by family income

Flavor and labeling	Family income					
	Low (Less than \$4,161)		Middle (\$4,161 to \$6,743)		High (Over \$6,743)	
	Mean	Number of respondents	Mean	Number of respondents	Mean	Number of respondents
Flavor:						
Sweetened -----	7.67	348	7.32	364	7.39	321
Unsweetened -----	7.71	397	6.50	375	7.10	406
Labeling:						
Labeled -----	8.06	338	6.98	367	7.53	380
Unlabeled -----	7.38	407	6.83	372	6.90	347

Table 6.--Respondents' descriptions of both labeled and unlabeled test canned grapefruit juices, by descriptive items

Descriptive item	Unlabeled										Labeled									
	Natural flavor - 10° Brix with Brix-acid ratio of --					Sugar added - 11.6° - 12.6° Brix with Brix-acid ratio of --					Natural flavor - 10° Brix with Brix-acid ratio of --					Sugar added - 11.6° - 12.6° Brix with Brix-acid ratio of --				
	7	9	11	13	15	7	9	11	13	15	7	9	11	13	15	7	9	11	13	15
Just the right sweetness --	31	48	63	53	68	35	55	58	66	68	35	55	58	66	68	35	55	58	66	68
Not sweet enough -----	60	41	34	36	19	60	32	31	30	9	60	32	34	28	14	64	24	22	22	14
Too sweet -----	2	2	1	4	9	1	7	1	6		1	4	2	1		9	4	8	8	14
Just the right tartness --	31	49	56	49	60	36	55	63	59	60	36	59	63	63	71	58	57	68	68	71
Too tart or sour -----	52	35	33	31	18	55	29	25	23	13	55	30	25	24	11	22	35	18	11	11
Not tart or sour enough --	4	5	5	8	13	3	7	6	8		3	2	3	3	12	5	5	9	9	12
Just the right body or consistency -----	55	61	80	69	70	65	70	75	75	70	65	68	75	67	74	73	71	77	77	74
Too thin or watery -----	33	25	18	26	18	25	22	20	16	3	25	24	17	24	20	22	21	18	18	20
Too thick -----	2	1	--	1	3	2	--	1	4		2	1	1	1	1	1	1	1	1	1
Tastes tinny -----	21	14	18	26	18	26	22	20	16	18	26	11	11	15	19	27	18	16	16	19
Tastes artificial -----	21	14	14	18	15	12	13	14	15	15	12	15	15	8	10	11	13	8	8	10
Tastes like fresh grapefruit juice -----	--	--	1	1	1	--	--	--	--	1	--	1	1	--	--	1	--	1	1	--
Does not taste like fresh grapefruit juice --	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Miscellaneous -----	2	--	--	--	--	1	--	1	--	--	1	--	1	1	--	1	1	--	--	--
Not ascertained -----	2	6	1	3	3	2	1	2	3	3	2	2	3	3	1	2	2	2	2	1
Number of respondents --	166	194	147	176	151	170	164	154	155	151	174	139	174	174	152	165	139	158	158	152

1/ Percentages add to more than 100 because some respondents checked more than 1 descriptive item.

Table 7.--Proportions of homemakers using fresh, frozen concentrated, and canned orange juice and grapefruit juice within the last year

Use of product	Orange juice			Grapefruit juice		
	Fresh	Frozen concentrated	Canned	Fresh	Frozen concentrated	Canned
	<u>Percent</u>	<u>Percent</u>	<u>Percent</u>	<u>Percent</u>	<u>Percent</u>	<u>Percent</u>
Used the product ---	67	69	65	34	24	67
Did not use the product -----	32	30	35	65	75	32
Not ascertained -----	1	1	<u>1/</u>	1	1	1
Total -----	100	100	100	100	100	100
Number of homemakers -----	622	622	622	622	622	622

1/ Less than 1 percent.

Table 8.--Proportions of homemakers using fresh, frozen concentrated, and canned orange juice and grapefruit juice, by family income

Use of product	Orange juice									Grapefruit juice								
	Fresh			Frozen concentrated			Canned			Fresh			Frozen concentrated			Canned		
	Low (less than \$4,161)	Middle (\$4,161 to \$6,743)	High (over \$6,743)	Low (less than \$4,161)	Middle (\$4,161 to \$6,743)	High (over \$6,743)	Low (less than \$4,161)	Middle (\$4,161 to \$6,743)	High (over \$6,743)	Low (less than \$4,161)	Middle (\$4,161 to \$6,743)	High (over \$6,743)	Low (less than \$4,161)	Middle (\$4,161 to \$6,743)	High (over \$6,743)	Low (less than \$4,161)	Middle (\$4,161 to \$6,743)	High (over \$6,743)
Used the product ----	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent
Did not use the product-	64	68	71	58	73	81	71	62	60	37	38	23	18	29	29	67	64	68
Not ascer- tained -----	35	32	28	41	26	18	29	37	39	63	61	76	81	70	70	32	35	31
Total ----	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Number of homemakers -	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
1/ Less than 1 percent.	198	176	157	198	176	157	198	176	157	198	176	157	198	176	157	198	176	157

Table 9.--Time of year when greatest use is made of fresh, frozen concentrated, and canned orange juice and grapefruit juice

Time of year when greatest use is made	Orange juice			Grapefruit juice		
	Fresh	Frozen concentrated	Canned	Fresh	Frozen concentrated	Canned
	Percent	Percent	Percent	Percent	Percent	Percent
Winter months --	26	11	13	33	15	12
Summer months --	21	27	18	9	20	14
Same all year round -----	52	61	68	58	64	73
Not ascertained-	1	1	1	<u>1/</u>	1	1
Total -----	100	100	100	100	100	100
Number of homemakers ---	419	430	402	212	149	419

1/ Less than 1 percent.

Table 10.--Frequency of use of fresh, frozen concentrated, and canned orange juice and grapefruit juice during the time of year greatest use is made of product

Frequency of use	Orange juice			Grapefruit juice		
	Fresh	Frozen concentrated	Canned	Fresh	Frozen concentrated	Canned
	Percent	Percent	Percent	Percent	Percent	Percent
Several times a week -----	85	85	81	74	72	77
About once a week	8	8	9	15	11	9
Less than once a week -----	7	7	9	11	17	14
Not ascertained -	--	<u>1/</u>	1	--	--	--
Total -----	100	100	100	100	100	100
Number of homemakers ----	419	430	402	212	149	419

1/ Less than 1 percent.

Table 11.--Relationship between yearly family income and frequency of use of fresh, frozen concentrated, and canned orange juice and grapefruit juice during the time of year when greatest use is made of a given product

Frequency of use	Orange juice												Grapefruit juice											
	Fresh				Frozen concentrated				Canned				Fresh				Frozen concentrated				Canned			
	Low (less than \$4,161)		Middle (\$4,161 to \$6,743)		Low (less than \$4,161)		Middle (\$4,161 to \$6,743)		Low (less than \$4,161)		Middle (\$4,161 to \$6,743)		Low (less than \$4,161)		Middle (\$4,161 to \$6,743)		Low (less than \$4,161)		Middle (\$4,161 to \$6,743)		Low (less than \$4,161)		Middle (\$4,161 to \$6,743)	
	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent
Several times a week -----	85	86	80	80	80	84	89	84	84	80	76	73	65	92	78	65	74	78	79	76				
About once a week -----	8	8	9	10	10	8	6	10	6	6	12	19	18	3	8	16	6	11	6	9				
Less than once a week -----	7	6	11	9	9	8	5	6	13	10	10	8	17	5	14	19	20	11	15	15				
Not ascertained -----	--	--	--	1	1	--	--	--	1	2		--	--	--	--	--	--	--	--	--				
Total -----	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100				
Number of homemakers --	126	119	112	114	128	128	128	140	110	95		73	66	37	36	51	46	133	113	107				

Table 12.--Reasons given for using fresh, frozen concentrated, and canned orange juice and grapefruit juice less than several times a week

Reasons given	Orange juice			Grapefruit juice		
	Fresh	Frozen concentrated	Canned	Fresh	Frozen concentrated	Canned
	Percent ^{1/}	Percent ^{1/}	Percent ^{1/}	Percent ^{1/}	Percent ^{1/}	Percent ^{1/}
Inconvenient; difficult to prepare--	47	2	--	48	--	--
Food habit reasons---	22	56	47	30	68	63
Cost; too expensive--	19	16	8	17	3	4
Fresh fruit juice not always good ---	10	--	--	2	--	--
Prefer the whole fruit -----	10	5	2	13	3	6
Too tart or sour ----	2	--	3	4	3	6
Prefer juice in bottles -----	2	--	2	2	--	1
Perishable -----	2	--	--	--	--	--
Too artificial -----	--	3	2	--	3	1
Too thin, watery, weak -----	--	3	5	--	--	4
Fresh juice better for health -----	--	3	5	--	--	3
Not available in stores -----	--	2	--	--	--	--
Too bitter, acid ----	--	2	5	2	5	15
No freezing unit or refrigerator ---	--	2	--	--	--	--
Tinny; metallic -----	--	--	9	--	--	4
Dislike taste, unspecified -----	--	--	5	--	--	3
Too sweet--not tart enough -----	--	--	2	--	--	--
Taste of rind, peel--	--	--	2	--	--	--
Miscellaneous health reasons -----	--	7	3	--	--	6
Miscellaneous other reasons -----	3	3	3	--	3	--
Just don't like it --	3	5	8	4	16	8
Not ascertained -----	7	14	16	2	5	6
Number of homemakers -----	58	57	64	46	38	79

^{1/} Percentages add to more than 100 because some homemakers gave more than 1 reason.

Table 13.--Reasons given for not using fresh, frozen concentrated, or canned orange juice and grapefruit juice within the last year

Reasons given	Orange juice			Grapefruit juice		
	Fresh	Frozen concentrated	Canned	Fresh	Frozen concentrated	Canned
	Percent ^{1/}	Percent ^{1/}	Percent ^{1/}	Percent ^{1/}	Percent ^{1/}	Percent ^{1/}
Difficult to prepare	61	7	1	34	3	--
Cost; too expensive -	14	19	2	3	9	2
Food habit reasons --	12	37	19	11	46	24
Prefer the whole fruit -----	8	4	1	52	7	9
Dislike--unspecified	4	6	4	5	5	11
Specific ailment prevents use -----	4	1	2	1	1	2
Perishable -----	3	1	2/	1	2/	--
Fresh fruit not always good -----	3	--	--	--	--	--
Miscellaneous health reasons -----	2	1	--	--	--	1
Dislike taste--unspecified -----	2	4	10	1	3	4
Causes indigestion --	2	2	1	1	2/	2
Prefer juice in bottle -----	1	4	2	--	--	--
Too bitter, acid ----	1	2	10	4	4	19
Too tart, sour -----	1	3	3	3	2	12
Not available in stores -----	1	1	2/	2/	6	--
Not economical--can too small -----	1	3	1	2/	1	--
Too sweet -----	1	2	2	--	2/	--
Low in vitamin content -----	1	2	2	--	2/	1
No freezing unit or refrigerator -----	--	3	--	2/	2	--
Too thin, watery, weak-	--	3	7	--	1	3
Too artificial -----	--	2	18	2/	2/	5
Fresh juice better for children, health	--	2	4	--	2/	1
Tinny, metallic -----	--	1	16	--	2/	13
Taste of rind, peel -	--	--	2	--	--	1
Miscellaneous taste reasons -----	--	--	2	--	1	2
Too acid for health -	--	--	2/	2/	--	1
Never heard of product	--	3	--	1	9	--
Miscellaneous other reasons -----	1	1	1	2/	2/	1
Not ascertained ----	2	2	2/	2/	2	3
Number of homemakers -----	198	187	217	407	469	198

^{1/} Percentages add to more than 100 because some homemakers gave more than 1 reason.

^{2/} Less than one-half of 1 percent.

Table 14.-- Ability to discriminate between canned grapefruit juices that vary in Brix-acid ratio with degrees Brix constant at 10° natural flavor and 11.6° - 12.6° sugar added

Control juice		Test juice		Judgments		
° Brix	Brix-acid ratio	° Brix	Brix-acid ratio	Correct	Incorrect	Total
				<u>Number</u>	<u>Number</u>	<u>Number</u>
10.0	13	10.0	11	6	14	20
10.0	13	10.0	9	23	13	36
10.0	13	10.0	7	30	6	<u>1/</u> 36
11.6	15	11.8	13	17	19	36
11.6	15	12.2	11	25	11	<u>1/</u> 36
12.2	11	12.6	9	19	17	36

1/ The number of correct judgments is significantly greater than would be expected by chance.

Table 15.--Ability to discriminate between canned grapefruit juices that vary in degrees Brix with Brix-acid ratio constant

Control juice		Test juice		Judgments		
° Brix	Brix-acid ratio	° Brix	Brix-acid ratio	Correct	Incorrect	Total
				<u>Number</u>	<u>Number</u>	<u>Number</u>
10.0	11	12.2	11	23	13	36
10.0	9	12.6	9	18	12	30

Table 16.--Ability to discriminate between canned grapefruit juices that vary in degrees Brix and Brix-acid ratio

Control Juice		Test juice		Judgments		
° Brix	Brix-acid ratio	° Brix	Brix-acid ratio	Correct	Incorrect	Total
				<u>Number</u>	<u>Number</u>	<u>Number</u>
10.0	7	12.6	9	28	8	$\frac{1}{36}$
11.6	15	10.0	13	26	10	$\frac{1}{36}$

$\frac{1}{36}$ The number of correct judgments is significantly greater than would be expected by chance.

